

CLAIMS

What is claimed is:

1. A fuel cell comprising:
 - an first manifold defined between a first gas-impermeable element and an active element;
 - a plurality of spacers disposed in said first manifold, each of said plurality of spacers and said first gas-impermeable element having an orifice formed therethrough;
 - a second manifold defined between said first gas-impermeable element and a second gas-impermeable element;
 - wherein a flow path is established from said first manifold through said orifice over said active element to said second manifold.
2. The fuel cell of claim 1 further comprising an electrically conductive path extending through the fuel cell to provide continuity from said active element, through said plurality of spacers and said first gas-impermeable element to said second gas-impermeable element.
3. The fuel cell of claim 2 wherein said plurality of spacers are electrically conductive.

4. The fuel cell of claim 3 wherein said electrically conductive path further comprises an electrically conductive filler disposed in a via formed through said first gas-impermeable element.

5. The fuel cell of claim 1 wherein said first gas-impermeable element is disposed in a substantially parallel spaced relation to said second gas-impermeable element such that said first manifold is substantially parallel with said second manifold.

6. The fuel cell of claim 1 further comprising a second plurality of spacer disposed in said second manifold.

7. The fuel cell of claim 1 wherein said plurality of spacers comprise a nested array of spacers disposed on said first gas-impermeable element.

8. The fuel cell of claim 1 further comprising a frame interposed between said first gas-impermeable element and said second gas-impermeable element.

9. The fuel cell of claim 1 wherein said plurality of spacers are equidistantly spaced on said first gas-impermeable element within said first manifold.

10. A fuel cell comprising:
 - an active element;
 - a first separator sheet disposed in spaced relation to said diffusion medium sheet to define a first manifold therebetween;
 - a first set of spacers disposed in said first manifold, each of said first set of spacers having an orifice transverse to said first manifold formed therein;
 - a second separator sheet disposed in spaced relation to said first separator sheet to define a second manifold therebetween transverse to said orifice; and
 - a second set of spacers disposed in said second manifold;

wherein a flow path is defined between said first manifold and said second manifold through said orifice across said active element.

11. The fuel cell of claim 10 further comprising an electrically conductive path extending through the fuel cell to provide continuity from said active element through said first set of spacers, said first separator sheet, said second set of spacers and said second separator sheet.
12. The fuel cell of claim 11 wherein said first and second sets of spacers are electrically conductive.

13. The fuel cell of claim 12 wherein said electrically conductive path further comprises an electrically conductive filler disposed in a via formed through each of said first and second separator sheets.

14. The fuel cell of claim 10 wherein said first separator sheet is disposed in a substantially parallel spaced relation to said second separator sheet such that said first manifold is substantially parallel with said second manifold.

15. The fuel cell of claim 10 wherein said set of first spacers comprise a nested array of first spacers disposed on said first separator sheet.

16. The fuel cell of claim 10 wherein a subset of said second spacers are at least partial superposed over an area defined by a subjacent first spacer of said set of first spacers with said first separator sheet interposed therebetween.

17. The fuel cell of claim 16 wherein said subset of second spacers are completely superposed over an area defined by a subjacent first spacer of said set of first spacers.

18. The fuel cell of claim 16 wherein said subset of second spacers comprises a spacer superposed over an area defined in part by a pair of subjacent first spacers of said set of first spacers.

19. The fuel cell of claim 10 further comprising a frame interposed between said first separator sheet and said second separator sheet, said frame circumscribing said second set of spacers.

20. The fuel cell of claim 19 further comprising a header formed in said frame and in fluid communication with one of said first manifold and said second manifold.

21. The fuel cell of claim 20 further comprising a set of runners formed in said frame between said header and one of said first manifold and said second manifold.

22. The fuel cell of claim 10 wherein each spacer of said first set of spacers comprise a disk with said orifice formed at a center thereof.

23. The fuel cell of claim 10 wherein said first set of spacers are equidistantly spaced on said first separator sheet within said first manifold.

24. The fuel cell of claim 10 wherein each of said first and second separator sheets comprise polyimide film.

25. The fuel cell of claim 24 wherein each of said spacers in said first and second sets of spacers comprise stainless steel elements.

26. A fuel cell comprising:
a membrane electrode assembly having a reactive face;
a planar manifold adjacent said reactive face;
a planar flow field interposed between said planar manifold and said membrane electrode assembly to provide a differential flow distribution across said reactive face.

27. The fuel cell of claim 26 wherein said planar flow field comprises a flow-interfering medium.

28. The fuel cell of claim 26 further comprising a pair of gas-impermeable sheets positioned in a spaced-apart relationship to define said planar manifold therebetween.

29. The fuel cell of claim 28 further comprising a plurality of spacers disposed in said planar manifold between said pair of gas-impermeable sheets.

30. The fuel cell of claim 29 wherein said plurality of spacers comprise a nested array of spacers.

31. The fuel cell of claim 28 wherein said planar manifold comprises an exhaust manifold section disposed adjacent said membrane electrode assembly and an inlet manifold section adjacent said exhaust manifold section.

32. The fuel cell of claim 28 further comprising a first gas-impermeable sheet and a second gas-impermeable sheet positioned in a spaced-apart relationship to define said inlet manifold section therebetween, said membrane electrode assembly and said second gas-impermeable sheet being positioned in a spaced-apart relationship to define said exhaust manifold section.

33. The fuel cell of claim 32 further comprising a plurality of spacers disposed in said exhaust manifold section.

34. The fuel cell of claim 33 wherein each of said plurality of spacers and said second gas-impermeable sheet has a passageway formed therethrough providing fluid communication between said inlet manifold section and said planar flow field.

35. The fuel cell of claim 34 wherein said plurality of spacers comprise a nested array of spacers.

36. The fuel cell of claim 33 further comprising a second plurality of spacer disposed between said first gas-impermeable sheet and said second gas-impermeable sheet within said planar inlet manifold.

37. A method of making a separator plate for a fuel cell comprising:

laminating a first conductive sheet onto a first film sheet;

removing a portion of said first conductive sheet from said first film sheet such that a remaining portion of said first conductive sheet defines a first array of spacers;

forming a passage through each of said spacers in said first array of spacers and said first film sheet to establish a plurality of flow paths;

laminating a second conductive sheet onto a second film sheet;

removing a portion of said second conductive sheet from said second film sheet such that a remaining portion of said second conductive sheet defines a second array of spacers; and

laminating said second array of spacers to a face of said first film sheet opposite said first array of spacers such that a first manifold is formed between said first film sheet and said second film sheet.

38. The method of claim 37 further comprising superposing a diffusion medium sheet over said first array of spacers such that a second manifold is defined between said first film sheet and said diffusion medium sheet.

39. The method of claim 37 further comprising forming an electrical connection between said first array of spacers and said second array of spacers through said first film sheet.

40. The method of claim 39 further comprising:
forming a via through said first film sheet at each spacer of said first array of spacers; and
disposing an electrically conductive material into said via to provide electrical continuity through said first film sheet.

41. The method of claim 40 further comprising:
forming a via through said second film sheet at each spacer of said second array of spacers; and
disposing an electrically conductive material into said via to provide electrical continuity through said second film sheet.

42. The method of claim 37 further comprising:
 - providing a sheet of polyimide film for said first film sheet; and
 - providing a sheet of polyimide film for said second film sheet.
43. The method of claim 37 wherein removing a portion of said first conductive sheet from said first film sheet comprises etching said portion of said first conductive sheet from said first film sheet in a predetermined pattern to form said first array of spacers.
44. The method of claim 37 wherein removing a portion of said second conductive sheet from said second film sheet comprises etching said portion of said second conductive sheet from said second film sheet in a predetermined pattern to form said second array of spacers.
45. The method of claim 37 further comprising aligning said second array of spacers to be at least partially supported by said first array of spacers.
46. The method of claim 45 wherein aligning said second array of spacers comprises aligning a subset of said second array of spacers at least partial over an area defined by a subjacent spacer of said first spacer array.

47. The method of claim 46 wherein aligning said second array of spacers further comprises aligning said subset of said second array of spacers completely over said area defined by said subjacent spacer.

48. The method of claim 45 wherein aligning said second array of spacers comprises aligning a second spacer over an area defined in part by a pair of subjacent first spacers of said first array of spacers.

49. The method of claim 37 further comprising laminating a frame in between said first film sheet and said second film sheet, said frame circumscribing said second array of spacers.